

*The Question of the Fine-Tuning of the Universe*

Cosmology is the study of the universe in its broadest sense. It's a discipline that asks such scientific and philosophical questions as: How did the universe come into being? What is the universe made of? Is the universe finite or infinite in size? What governs the physical laws and constants of the universe? Answers to these questions have occupied the minds of humankind since the beginning of history.

Since the time of the Enlightenment, faith and science have been at odds with one another. Whether it is the question of origin or humanity's view of the natural world, faith and science have often been viewed as holding opposing perspectives. In this lesson, we will examine how a scientific understanding of the natural world gives support to the reality of a Creator by investigating the fine-tuning of the universe.

Most people today are familiar with computers. Whether they come in the form of smart phones, laptops, tablets, watches, or other types of digital devices, computers of every sort touch our lives in a myriad of ways. The programs that make these computers function as they do are composed of individual, clearly thought-out instructions that when combined create processes which in turn create some type of output. An instruction could include something as simple as "add 2 + 2" with a second instruction to "show result on screen." All computer programs require these kinds of instructions written in small pieces of code that are created by some form of external intelligence. Nobody would seriously think that a computer, without influence from an outside programmer, could develop its own programs. The same is true of the universe. The universe by its very design and composition attests that it was created by an outside intelligence.

Many in the scientific community speak of the universe being fine-tuned, that is, existing within specific parameters allowing life to occur as it does. And although this is not an admission on the part of science that the God of the Bible, or any god for that matter, exists, it does open the door to the reality that our universe is uniquely made to support life and does so within very small tolerances.

From the macro world of planets, stars, and galaxies to the micro world of atoms and quantum particles, life in the universe exists within specific constraints that if changed even slightly would cause life to cease. The question that arises is, why? Why does the universe possess such fine-tuning?

Some say the universe is the way it is because, of all possible outcomes that could have existed, this is the one that exists. Therefore, the universe is merely the result of time, matter, and chance. The probability, however, of our universe being able to support the diversity of life that it does is highly improbable, which is why scientists speak of the cosmos being fine-tuned. It is as though the dials of the universe were set to specific values by a cosmic engineer.

Suppose, for example, you sit down with someone to play a game of five-card, no-draw poker. Now imagine that on the first hand your opponent shows that she received a royal flush; that is a ten, jack, queen, king, and ace of the same suit. Given that the chance of drawing a royal flush is 649,740 to 1, or 0.000153 percent, you would say your opponent was lucky. If, however, your opponent drew the same hand five times in a row, you would say your opponent was cheating.

It has been estimated that the chances of life arising in the universe from nonliving matter are 1 in  $10^{40}$ , that is, 1 followed by forty zeros.<sup>1</sup> To put this probability in perspective, we need to understand how large the number  $10^{40}$  is. Consider the following.

The chances of a person being struck by lightning are 1 in  $10^5$ , which is also the chance of giving birth to quadruplets. The chances of winning the lottery are 1 in  $10^8$ . As of the writing of this lesson, the current value of the national debt in the United States is around  $27 \times 10^{12}$ , or twenty-seven trillion dollars. To get even higher values, the number of grains of sand on earth is estimated to be  $7.5 \times 10^{18}$  and the number of atoms in a single grain of sand is around  $3 \times 10^{20}$ . These values are so large that we are unable to comprehend them adequately. What we learn from them is that the chances of life forming from nonliving matter in the universe to the degree of human intelligence are astronomically unlikely, yet here we are. Humanity is either the biggest accident ever to

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1. The process of life arising out of non-living matter is called *abiogenesis*. And while we are using a much more conservative number of 1 in  $10^{40}$  chances, some have estimated the chances to be as low as one chance in 10390, a number that is essentially impossible to comprehend given that the total estimated number of atoms that make up all matter in the universe is around  $10^{80}$ .

occur or there is a Designer who created this world to sustain life as it does.

In lesson two we referred to Psalm 19:1–4 where the psalmist writes,

The heavens are telling of the glory of God; and their expanse is declaring the work of His hands. Day to day pours forth speech, and night to night reveals knowledge. There is no speech, nor are there words; their voice is not heard. Their line has gone out through all the earth, and their utterances to the end of the world. (NASB)

In these few verses the psalmist speaks to the reality of what is called general revelation: that God demonstrates His existence through what He has created.

Perhaps you have stood outside on a clear night and observed the billions of stars that dot the sky. What we see with the naked eye pales in comparison to how big the universe really is. In 2004 the Hubble telescope was focused on a dark part of the sky about the size of a quarter held up at arm's length. Within this small section of seemingly empty space the Hubble telescope discovered more than 10,000 galaxies that exist far beyond what the unaided eye can see. Again, these are not stars, but galaxies, each containing billions of individual stars.

At the other end of the spectrum are extremely small particles that, when combined, make up the elements from which all matter in the universe is built. These particles include atoms, the basic building block of matter, and even smaller particles that exist on the quantum level. The parameters within which these particles exist also speak to the existence of a Designer.

The fine-tuning of the universe can be thought of as a cake recipe. You can slightly vary the amounts of the ingredients and still make a tasty cake. But deviate too far, add too many extra ingredients, or leave out too many ingredients, and you will have a mess on your hands.

Several fundamental laws and physical constants make up this fine-tuning, and there are many resources that delve deep into this area of study. Two books I would highly recommend are *Improbable Planet* by Hugh Ross and *A Fortunate Universe* by Geraint Lewis and Luke Barnes. For our purposes in this lesson, we

will only address a handful of laws and constants that if changed even slightly would eliminate the possibility of life as we know it.

The universe possesses what is called the cosmological constant. That is, a force related to the expansion rate of the universe and associated to the amount of dark energy in existence. Recent discoveries in science have concluded that the value of this force maintains a very sensitive balance of one part in  $10^{37}$ . Hugh Ross gives an example of how delicate this value is.<sup>2</sup> Consider covering the whole of North America with dimes all the way up to the moon, about 239,000 miles high. Then add the same amount of dimes on a billion other continents the same size as North America and place one red dime in the mix of all the dimes. Now, have a blindfolded person randomly pick one of the dimes. The chance of a person picking the one red dime out of all the dimes is one in  $10^{37}$ . If the cosmological constant were changed by this infinitesimally small amount, then the universe would have expanded either too rapidly or too slowly, thereby preventing life from existing in the universe.

Similarly, if the gravitational constant were varied by one part in  $10^{60}$ , the universe would have expanded so rapidly that stars would not have formed or formed too slowly causing the universe to collapse in on itself. Either way, life would not exist. Furthermore, if the mass and energy of the early universe had not been evenly distributed to a precision of one part in  $10^{1230}$  then the universe would be hostile to life of any kind.

Another constant in the universe that determines whether life exists is the strong nuclear force, the force that holds the nucleus of an atom together. If this force were slightly stronger, then hydrogen atoms would not survive to create the heavier elements that make life impossible. If the force were slightly weaker, then hydrogen atoms could never form and again create the heavier elements needed for life.

Outside the nucleus of an atom is the electron, where the type of atom determines how many electrons there are. When one atom combines with another atom to form a molecule, the positive charge of the protons and the negative charge of the electrons bind to hold the atoms together. The mass of the proton is just less than two thousand times larger than the mass of the electron, a ratio that if changed slightly would jeopardize the stability of

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2. Hugh Ross, *The Creator and the Cosmos* (Downers Grove: NavPress Publishing 2004), p. 115.

the bond and make life unachievable.

Other universal constants that exist within tiny parameters of value include the electromagnetic force and its ratio to the gravitational force, the number of protons to the number of electrons, the amount of entropy in the universe, the speed of light, the average distance between one galaxy and another and one star and another, the density of galaxy clusters, the decay rate of protons, and the ratio between the mass of a neutron and the mass of a proton, which together make up the nucleus of an atom. All these relationships and the ratio between them determine whether life exists or does not exist in the universe.

Closer to home, within our own solar system, the earth rotates around the sun at a unique distance called the Goldilocks zone, not too far and not too close so as to allow for a temperature range allowing human habitation. The earth's rotation, axis tilt, oxygen level, and seismic activity are specifically designed for life on this planet.

If the rotation of the earth were longer than twenty-four hours in duration, then the temperature difference between night and day would be too great; if the rotation were shorter in duration, atmospheric winds would be too strong for life to continue.

If the earth's tilt of 23 degrees were greater or lesser, the surface temperatures would be too extreme to support life because of the angle of the sun hitting the earth throughout the year.

If the earth's current oxygen level of 21 percent rose to 25 percent, fires would occur spontaneously; but if it were lowered to 15 percent, humanity would not be able to breathe. Even the thickness of the earth's crust is important for the existence of life. If the crust were thinner, then tectonic shifting and volcanic activity would make life impossible.

In addition, the number and frequency of lightning strikes, the transparency of the atmosphere which determines the amount of solar radiation that reaches the earth's surface, the moon's gravitational interaction on tidal effects, and the amount of water vapor levels in the atmosphere (which determines surface temperature and the greenhouse effect) all significantly affect life on our planet.

Our world, and the universe as a whole, has been uniquely designed

to support life, specifically human life. According to Lewis and Barnes, if life does exist elsewhere in the universe we would expect it to be on the molecular level and not the intellectual level as with our earth.<sup>3</sup> Life as we know it is special and unique. And while science doesn't know exactly how life began, we do see how it is sustained and that it exists within very fine parameters. Even a single-celled organism is a miracle of complexity.

For life to exist, you need the building blocks of the universe: atoms; the fundamental forces of nature by which atoms interact; and the laws of physics, which form molecules, build planets, power the sun, and drive the chemistry of life. In other words, you need an environment that has been specially designed for life to exist and thrive.

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3. Geraint Lewis and Luke Barnes, *A Fortunate Universe: Life in a Finely Tuned Cosmos* (Cambridge: Cambridge University Press 2018), p. 6.